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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/637,094	08/06/2003	Bruno Ghyselen	4717-6300	9064

28765 7590 05/03/2005

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EXAMINER
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PHAM, THANH V

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 05/03/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

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<b>Office Action Summary</b>	<b>Application No.</b> 10/637,094	<b>Applicant(s)</b> GHYSELEN ET AL.	
	<b>Examiner</b> Thanh V. Pham	<b>Art Unit</b> 2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 18 February 2005.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-20 and 23-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-20 and 23-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

## **DETAILED ACTION**

### ***Response to Amendment***

#### ***Claim Objections***

1. New claim 26 is objected to because of the following informalities: "initially" should be deleted because the pointed-to support paragraph ([0157] in the US Pub. No. 2004/0087042 A1 and the instant Specification page 34, lines 27-32) does not teach this step "initially" start the method for adjusting the thickness of a thin film. Appropriate correction is required.

#### ***Claim Rejections - 35 USC § 102***

2. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.
3. Claims 1-8, 12, **16**, 17, **18-20**, 23-24 and 26 rejected under 35 U.S.C. 102(a) as being anticipated by Vuong et al. US 2004/0017574 A1.

*Re claim 1*, the Vuong et al. reference teaches a method for adjusting the thickness of a thin semiconductor material layer, figs. 1-2 and the associated paragraphs, which comprises:

measuring the layer [0037], e.g., to establish a thickness profile [0046], steps 330, 340 of fig. 2, e.g.;

comparing the measured thickness profile with stored standard profiles [0037], [0050], e.g., wherein each standard profile is stored in association with respective thickness adjustment specifications [0052], e.g.;

selecting a stored standard profile to associate the layer with the respective thickness adjustment specification [0003], [0010], [0048] and fig. 5, e.g.; and

adjusting the thickness of the layer in accordance with the thickness adjustment specification [0055], [0061], [0084], [0087], [0096], steps 380-398 of fig. 2, e.g.

*Re claim 2*, the thickness adjustment specifications are recipes 54, [0066], e.g.

*Re claim 3*, the method which further comprises establishing association between the stored standard profiles and the recipes [0037], fig. 3, e.g.

*Re claim 4*, the method further comprises establishing associations by using an algorithm having a target specification input for thickness profile established for layer fabrication [0086], e.g.

*Re claim 5*, the method further comprises using identical meshes to establish the thickness measurements, the standard profiles, and the target specification [0039], [0040], e.g.

*Re claim 6*, the method further comprises automatically reactivating the configuration algorithm on each change of target specification to establish a new configuration defining correspondences between the standard profiles and the recipes [0086], e.g.

*Re claims 7-8*, the method further comprises storing at least one configuration associated with the thickness measurement or a plurality of configurations, and selecting a desired configuration [0091], e.g.

*Re claim 12*, wherein the algorithm selects categories of recipes as a function of thickness differences between the target and the standard profile to establish a configuration, without searching through all recipes [0086], [0092] and fig. 4, e.g.

*Re claim 17*, the Vuong et al. reference further discloses in [0075] oxide thickness as an optimize parameter selection in a process example, “the model identification may be .. silicon dioxide thickness”, [0097], e.g.

*Re claim 20*, wherein the recipes correspond to at least one of uniform thickness modification across the layer, or differential thickness modification across the layer [0075] and figs. 12, e.g.

*Re claim 23*, wherein each standard profile is stored in storing means 1850/1860 and the measured thickness profile is compared with stored standard profiles by a processor unit 1840 associated with the storing means, with the processor configured to receive measurements made on the layer from thickness measuring means 1860, and to forward thickness adjustment specifications to thickness adjustment means 1830, fig. 6A, e.g.

*Re claim 24*, the thickness measuring means is at least one of an ellipsometer and a reflectometer [0007], [0036], [0037], [0040], e.g.

*Re claim 16*, the method as of claim 1 further comprises applying thickness adjustments *simultaneously* to the layer surface, wherein the adjustments may differ depending on location on the layer surface [0072], [0095]-[0097], e.g.

*Re claims 18-19 and 26*, the method as of claim 1 further comprises treating batches of layer, wherein one layer thickness in the batch is adjusted by a certain given pitch while a subsequent layer thickness is being measured; wherein the layers of a given batch share the same final target thickness, and the recipe for each layer is individualized to ensure that once thickness adjustment has been completed, a mean

layer thickness is obtained for the batch that is as close as possible to the common target [0084]-[0086], e.g., "the regression results such as ... film thickness, and profile from the parameter selector ... may be used by a system user to fine-tune the ... fabrication process. Alternatively, the regression results may be used to adjust variables and/or physical controls of the fabrication process", [0096], e.g.

### ***Claim Rejections - 35 USC § 103***

4. Claims 9-11 and 13-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Vuong et al. as applied to claims 1-8, 12, 16-20, 23-24 and 26 above, and further in view of Ferrell et al. US 6,751,343 B1.

The Vuong et al. reference though teaches a method as in the above, refers to use of data-gathering criterion to test/compare whether sufficient data about the structure is available to perform the model and parameter selection [0056] and make a final selection of optimization parameters based on one or more selection criteria [0084]; although the flowchart/diagram of fig. 5 resembles a tree structure having selecting zones of the standard profile (*re claim 10*) defined by recipe parameters (*re claim 14*), provides the step 375 of fig. 2 for adjusting the profile model and/or the parameter selection criteria (*re claim 13*), it discloses **neither** the tree structure defining categories and sub-categories with a desired number of levels (*re claim 9*), finer and finer levels of detail (*re claim 11*), wherein the high level categories of recipes in the recipe tree structure include: a first high level recipe category defining a uniform thickness adjustment specification for the entire surface of the layer; and additional high

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level categories depending on overall distribution parameters for thickness adjustment specifications over the surface (*re claim 15*) **nor** establishing a link between a starting level of a standard profile tree structure and an arrival level of a recipe tree structure, such that for each standard profile belonging to a given category of starting level there exists an arrival level category of recipes; searching for a recipe for a standard profile at the starting level by automatically directing the search towards the arrival level category; and continuing the search by going deeper into the recipe tree structure to establish a configuration (*re claim 13*).

The Ferrell et al. reference teaches a system and method for indexing and retrieving data for subsequent fast retrieval (col. 2, lines 50-52) so that a corrective action can be quickly taken (col. 2, line 44), the tree diagram of fig. 6 depicts a hierarchical search tree for use with the method of fig. 7 wherein defining categories and sub-categories with desired number of levels and finer and finer levels of detail. The method "has been applied to continuously manufactured web products such as ... thick and thin film ceramics" col. 8, lines 40-43. The "method ... can be subdivided into two process: a method for indexing ... and a method for retrieving, col. 5, lines 62-65. The method for indexing begins in step 10 of fig. 3A, adding feature vector to vector list at step 18, creating node after loading next feature vector then inserting top-down node in indexing tree (steps 28-32 in fig. 3B). Fig. 7 is a flow chart illustrating a method for retrieving information stored in a hierarchical tree structure as in fig. 6. wherein the search for a standard profile at the starting level by automatically directing the search towards the arrival level category (steps 42, 44) and continuing the search by going deeper into the recipe tree structure to establish a configuration (steps 48, 60).

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It would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the hierarchical tree structure of Ferrell et al. into the library of Vuong et al. as the tree structure would be selected in accordance with the method for adjusting the thickness of a thin semiconductor material layer in order to index and retrieve data for subsequent fast retrieval so that a corrective action can be quickly taken in the manufacturing process as taught by Vuong et al.

5. Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Vuong et al. and Ferrell et al. as applied to claim 1 above, and further in view of applicant's admitted prior art.

The Vuong reference does not mention to a particular hydrogen annealing. The applicant's admitted prior art, US 6,403,450 provide by the applicant, teaches hydrogen annealing is "an additional step of annealing the substrate is added to enable the layer to be cured of surface irregularities generated during oxidation and during the preceding steps in the method of preparing the thin layer" (the instant specification's page 25). It would have been obvious to one of ordinary skill in the art at the time of the invention to provide the process of Vuong et al. with the known step as taught by applicant's admitted prior art because the additional step would provide the process of Vuong with the cure for the formed layer.



***Response to Arguments***

6. Applicant's arguments filed 02/18/2005 have been fully considered but they are not persuasive.
7. In response to applicant's argument that the Vuong reference is in contrast with the instant invention (the Remark's page 7) and further states that "there is no teaching in Vuong to modify the thickness or surface profile of the layer" (page 8), applicant is directed to Vuong's [0007]-[0010], [0037], [0046], e.g., wherein

[0037] ... The diffraction beam 49 is measured by a metrology beam receiver 51. The diffraction beam data 57 is transmitted to a profile application server 53. The profile application server 53 compares the measured diffraction beam data 57 against a library 54 of calculated diffraction beam data representing varying combinations of critical dimensions of the target structure and resolution of the critical dimensions. In one exemplary embodiment, the library instance in library 54 best matching the measured diffraction beam data 57 is selected. The profile and associated critical dimensions of the selected library instance may provide a two-dimensional or three-dimensional representation of the grating structure. ...

[0055] ... techniques may include structure characterization obtained from an integrated circuit fabrication process ...

[0066] ... the nominal values and ranges of the geometric parameters are obtained. These values and ranges are typically obtained from historical or test data for the fabrication process or recipe. ...

[0067] In step 540, the dependencies of the geometric parameters are defined. Again, the dependencies of the geometric parameters are based on historical or test results for the particular fabrication process of recipe. ...

[0072] ... Several tasks may be **concurrently** or **serially** performed to provide information as to whether an optimization parameter should be selected or excluded. ...

[0084] ... If an optimization parameter is not selected, then the optimization parameter is set to a fixed value, the fixed value determined from fabrication data or previous experience with the recipe. ...

[0091] FIG. 6C is an architectural diagram of a metrology model optimizer in an exemplary embodiment. The system configuration is similar to the system in FIG. 6B except that instead of processing request for critical dimension data 1924 exclusively from the profiler workstation 1925, in-line requests 1931 for the same data is transmitted from an optical metrology system 1930. The optical metrology system 1930 is coupled to a fabrication cluster 1940, which may be a clean track unit, lithography machine, an etch machine or a combined lithography-and-etch unit. As a wafer (not shown) completes a fabrication

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process step, structures on the wafer are measured by the optical metrology system 1930 creating measured diffraction signals 1931 transmitted to the metrology model optimizer 1920. In addition to the critical dimension data 1924 being transmitted to the profiler workstation 1925, the same data is transmitted to the fabrication cluster 1940 for advanced process control use. The critical dimension data 1924 may be used by the fabrication cluster 1940 to adjust process variables of the fabrication process. The profiler workstation 1925 sends requests 1926 for critical dimensions, profiles, and film thickness of measured diffraction signals and other input data (not shown) characterizing the structures on the wafer or location of similar data stored in the metrology model optimizer 1920. The optical metrology system 1930 receives transmitted data 1941 from the fabrication cluster 1940 regarding completion of one or more fabrication processes. After completing the measurements of structures on the wafer, the optical metrology system transmits signals 1941 to the fabrication center 1940 to indicate completion of optical metrology measurements.

[0096] ... results may be used to adjust variables and/or physical controls of the fabrication process. ...the profile model and optimization parameters selected may be used to create a library of simulated signals and associated profile data.

The thickness of a film in process is also mentioned to in many paragraphs amongst several examples, [0046], [0064], [0075], e.g.

It is clearly that the above passages are equivalent with the instant invention steps of measuring, comparing, selecting and adjusting in a method for adjusting the thickness of a thin semiconductor material layer of claim 1 not just "the model profile of Vuong's process is directly defined after the characterization of the wafer structure with possible optimizatrion taking in count the selection criteria, before the test with the predetermined criteria" as alleged (the Remark's page 8, lines 7-10) and therefore the Vuong reference does not distinct from the claimed instant invention.

8. In response to applicant's argument on the rejection under 103(a), the response to Vuong's is as in the above. Ferrll is used for "a hierarchical search tree for use with the method wherein defining categories and sub-categories with desired number of levels and finer and finer levels of detail" and further, the method "has been applied to

continuously manufactured web products such as ... thick and thin film ceramics" col. 8, lines 40-43 wherein the tree structure of Vuong is modified and made clear although, in Vuong, the flowchart/diagram of fig. 5 resembles a tree structure having selecting zones of the standard profile defined by recipe parameters, provides the step 375 of fig. 2 for adjusting the profile model and/or the parameter selection criteria.

9. The argument on Wolf related to claim 17 is moot in view of Vuong as described in the above rejection.

10. The arguments on claim 16 and 18 are responded the same in section 7.

### ***Conclusion***

11. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

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13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thanh V. Pham whose telephone number is 571-272-186. The examiner can normally be reached on M-T (6:30-5:00).


If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

TvP

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04/22/2005

  
George Fourson  
Primary Examiner